304-CD-004-003

EOSDIS Core System Project

Flight Operations Segment (FOS) Requirements Specification for the ECS Project Volume 2: AM-1 Mission Specific

Subject to government approval and
not intended for general distribution.

October 1995

Hughes Information Technology Corporation
Upper Marlboro, Maryland

FOS Requirements Specification for the ECS Project Volume 2: AM-1 Mission Specific

October 1995

Prepared Under Contract NAS5-60000
CDRL Item 045

SUBMITTED BY

Cal E. Moore Jr. /s/ 9/27/95

Calvin Moore, FOS CCB Chairman Date
EOSDIS Core System Project

Hughes Information Technology Corporation
Upper Marlboro, Maryland

304-CD-004-003

This page intentionally left blank.

Preface

This document is a formal contract deliverable with an approval code 1. It requires Government review and approval prior to acceptance and use. This document is under ECS contractor configuration control. Once this document is approved, Contractor approved changes are handled in accordance with Class I and Class II change control requirements described in the EOS Configuration Management Plan, and changes to this document shall be made by document change notice (DCN) or by complete revision.

The changes in the document version are focused on general requirements identified during the FOS detail phase. This is based on discussions with the AM-1 project and other technical meetings.

Any questions should be addressed to:

Data Management Office
The ECS Project Office
Hughes Information Technology Corporation
1616 McCormick Drive
Upper Marlboro, MD 20774-5372

This page intentionally left blank.

Abstract

This document specifies the Level 4 requirements for the Flight Operations Segment (FOS). Volume 1 pertains to the general Level 4 requirements. Volume 2 pertains to the AM-1 mission specific Level 4 requirements.

Keywords: Level 4, requirement, FOS

This page intentionally left blank.

Change Information Page

List of Effective Pages	
Page Number	**Issue**
Title	Submitted as Final
iii through xiv	Submitted as Final
1-1 and 1-2	Submitted as Final
2-1 through 2-4	Submitted as Final
3-1 and 3-2	Submitted as Final
4-1 through 4-4	Submitted as Final
5-1 through 5-4	Submitted as Final
6-1 through 6-16	Submitted as Final
7-1 through 7-14	Submitted as Final
8-1 through 8-4	Submitted as Final
9-1 through 9-10	Submitted as Final
A-1 and A-2	Submitted as Final
B-1 and B-2	Submitted as Final
C-1 and C-2	Submitted as Final
AB-1 and AB-1	Submitted as Final
GL-1	Submitted as Final

Document History			
Document Number	**Status/Issue**	**Publication Date**	**CCR Number**
304-CD-004-001 304-CD-004-002 304-CD-004-003	Review Copy Original Submitted as Final	November 1994 January 1995 October 1995	94-0160 95-005 95-0439, 95-0440, and 95-0442 , 995-0443, 95-0444, 95-0445, 95-0446, 95-04427, 95-0448

This page intentionally left blank.

Contents

1. Introduction

2. Related Documentation

3. Flight Operations Segment Overview

4. FOS Segment Requirements

5. Hardware Requirements

6. Scheduling Requirements

7. Real-Time Operations

8. Analysis

9. Support Services

Tables

Appendix A. Level 4 Traceability Matrix

Appendix B. Level 4 Attributes Matrix

Appendix C. Level 3 to Level 4 Traceability Matrix

Abbreviations and Acronyms

Glossary

This page intentionally left blank.

1. Introduction

1.1 Identification

The Flight Operations Segment (FOS) Requirements Specification for the ECS Project, Contract Data Requirements List (CDRL) Item 045, whose requirements are specified in Data Item Description (DID) 304/DV1, is a required deliverable under Contract NAS5-6000.

1.2 Scope

The FOS Requirements Specification defines the FOS Level 4 Requirements. The FOS Level 4 Requirements are comprised of two volumes: (1) Volume 1 focuses on the general FOS Level 4 requirements; (2) Volume 2 contains the AM-1 Mission Specific Requirements.

This document reflects the August 23, 1995 Technical Baseline maintained by the contractor configuration control board in accordance with ECS Technical Direction No. 11 dated December 6, 1994. It covers releases A and B for FOS. This corresponds to the design to support the AM-1 launch.

1.3 Purpose

The general requirements are defined as the set of requirements that FOS will provide to support any U.S. EOS spacecraft. These requirements were derived from the Level 3 requirements, as defined in the Functional and Performance Requirements for ECS and Interface Requirements Documents (IRDs). Note that in some cases, a general requirement may not be implemented if a mission specifically does not require the capability. This status will be denoted in Appendix A, Level 4 Traceability Matrix.

The mission specific requirements are defined as the set of requirements that pertain uniquely to support the command and control of a specific U.S. EOS spacecraft. In particular, Volume 2 contains the mission-specific FOS requirements for the AM-1 mission. Note that Volume 2 is organized identical to Volume 1 for consistency purposes. In addition, the subsection titles are identical for easier reference and traceability. In many cases, the subsections are referenced even though mission-specific requirements are not defined for the subsection.

1.4 Status and Schedule

This submittal of DID 304/DV1 incorporates comments received during the Flight Operations Segment Preliminary Design Review (PDR), and is the final submittal of this document. This document is now under ECS CCB control; all changes must be approved by this CCB prior to inclusion in the document.

1.5 Organization

The document is organized to describe the Level 4 Flight Operations Segment (FOS) requirements.

Section 1.0 provides information regarding the identification, scope, status, and organization of this document.

Section 2.0 provides a listing of the related documents, which were used as source information or this document.

Section 3.0 provides an overview of the FOS, focusing on the FOS high-level operational concept. This provides general background information to put FOS into context.

Section 4.0 contains the set of FOS segment-wide requirements.

Section 5.0 contains the FOS hardware requirements.

Section 6.0 contains the requirements associated with the Scheduling activity phase. This includes the Planning and Scheduling subsystem and the Command Management subsystem.

Section 7.0 contains the requirements associated with the Real-Time Operations activity phase. The includes the Resource Management, Telemetry and Command subsystems.

Section 8.0 contains the requirements with the Analysis activity phase. This includes the Analysis subsystem.

Section 9.0 contains the requirements associated with subsystems that provide services used for the three FOS activity phases. This includes the User Interface subsystem and the Data Management subsystem.

Appendix A contains a table defining whether each level 4 requirements is an IST requirement. Note that the IST requirements are defined in Section 4 through 9 of this volume. In particular, any requirement that includes the text “The FOS shall” pertains to a requirement that is applicable to both the EOC and the IST. Any requirement that includes the text “the EOC shall” pertains to a requirement that is applicable to the EOC, not the IST. Any requirement that also includes the test “the IST shall” also pertains to a requirement that is applicable to the IST. Note that a listing of each of the IST requirements is included in the IST Capabilities Document.

Appendix A also contains the Traceability Matrix for Level 4 requirements to the Release, the Level 3 Requirements, whether the Level 4 requirement is an IST requirement, the test method, and whether the Level 4 requirement will be implemented by CSMS.

Appendix B contains the Level 4 Attributes Matrix.

Appendix C contains the Level 3 to Level 4 Traceability Matrix.

The section Abbreviations and Acronyms contains an alphabetized list of the definitions for abbreviations and acronyms used in this volume.

The section Glossary contains a list of terms used in this volume.

2. Related Documentation

2.1 Parent Document

The parent document is the document from which this FOS Requirements Specification scope and content are derived.

194-219-SE1-001	Interface Requirements Document Between EOSDIS Core System (ECS) and the NASA Science Internet (NSI)
423-41-02	Goddard Space Flight Center, Functional and Performance Requirements Specification for the Earth Observing System Data and Information System (EOSDIS) Core System
505-41-15	Goddard Space Flight Center, Interface Requirements Document Between EOSDIS Core System (ECS) and Earth Observing System (EOS) AM-1 Flight Operations
505-41-18	Goddard Space Flight Center, Interface Requirements Document Between EOSDIS Core System (ECS) and MITI ASTER GDS Project
505-41-19	Goddard Space Flight Center, Interface Requirements Document Between the EOSDIS Core System (ECS) and the National Oceanic and Atmospheric Administration (NOAA) Affiliated Data Center (ADC)
540-022	Goddard Space Flight Center/MO&DSD, Earth Observing System (EOS) Communications (Ecom) Interface Requirements Document
560-EDOS-0211.0001	Goddard Space Flight Center/MO&DSD, Interface Requirements Document Between EDOS and the EOS Ground System (EGS) Elements, Preliminary

2.2 Applicable Documents

The following documents are referenced within this FOS Requirements Specification, or are directly applicable, or contain policies or other directive matters that are binding upon the content of this volume.

194-207-SE1-001	System Design Specification for the ECS Project
304-CD-005-001	Release B SDPS/CSMS System Requirements Specification for the ECS Project
604-CD-001-004	Operations Concept for the ECS Project: Part 1-- ECS Overview
604-CD-002-002	Operations Concept for the ECS project: Part 2B -- ECS Release B

604-CD-003-001	ECS Operations Concept for the ECS Project: Part 2A -- ECS Release A
604-CD-004-001	ECS Operations Concept for the ECS Project: Part 2 -- FOS
194-813-SI4-001	Instrument Support Toolkit Prototype Results for the ECS Project
CCSDS 102.0-B-3	Consultative Committee for Space Data Systems (CCSDS) Recommendation for Space Data System Standards -- Packet Telemetry; Blue Book
CCSDS 202.0-B-2	Consultative Committee for Space Data Systems (CCSDS) Recommendation for Space Data System Standards -- Telecommand, Part 2 Data Routing Service; Blue Book
CCSDS 202.1-B-1	Consultative Committee for Space Data Systems (CCSDS) Recommendation for Space Data System Standards -- Telecommand, Part 2.1 Command Operation Procedures; Blue Book

2.3 Information Documents

The following documents are referenced herein and, amplify or clarify the information presented in this document. These documents are not binding on the content of the ECS FOS Requirements Specification.

209-CD-002-002	Interface Control Document Between EOSDIS Core System (ECS) and ASTER Ground Data System
209-CD-003-002	Interface Control Document Between EOSDIS Core System (ECS) and the EOS-AM Project for AM-1 Spacecraft Analysis Software
209-CD-004-002	Data Format Control Document for the Earth Observing System (EOS) AM-1 Project Data Base
313-CD-004-002	Release A CSMS/SDPS Internal Interface Control Document for the ECS Project
410-TD-001-002	ECS User Interface Style Guide
194-00602TPW	[Instrument Support Toolkit] IST Capabilities Document for the ECS Project, Working Paper
502-ICD-JPL/GSFC	Goddard Space Flight Center/MO&DSD, Interface Control Document Between the Jet Propulsion Laboratory and the Goddard Space Flight Center for GSFC Missions Using the Deep Space Network
530-ICD-NCCDS/MOC	Goddard Space Flight Center/MO&DSD, Interface Control Document Between the Goddard Space Flight Center Mission Operations Centers and the Network Control Center Data System

530-ICD-NCCDS/POCC	Goddard Space Flight Center/MO&DSD, Interface Control Document Between the Goddard Space Flight Center Payload Operations Control Centers and the Network Control Center Data System
530-DFCD-NCCDS/POCC	Goddard Space Flight Center/MO&DSD, Data Format control Document Between the Goddard Space Flight Center Payload Operations Control Centers and the Network Control Center Data System
540-041	Interface Control Document (ICD) Between the Earth Observing System (EOS) Communications (Ecom) and the EOS Operations Center (EOC), Review
560-EDOS-0230.0001	Goddard Space Flight Center/MO&DSD, Earth Observing System (EOS) Data and Operations System (EDOS) Data Format Requirements Document (DFRD)
ICD-106	Lockheed Martin, Interface Control Document (ICD) Data Format Control Book for EOS-AM Spacecraft
SD-110a	Lockheed Martin, EOS-AM Spacecraft Flight Software -- Software Requirements Specification
none	Goddard Space Flight Center, Earth Observing System (EOS) - AM1 Flight Dynamics Facility (FDF)/EOS Operations Center (EOC) Interface Control Document (ICD), Draft
none	Goddard Space Flight Center, EOS AM-1 Ground Systems Requirements
none	Goddard Space Flight Center, Detailed Mission Requirements AM-1 Spacecraft

This page intentionally left blank.

3. Flight Operations Segment Overview

See Volume 1 for information pertaining to this section.

This page intentionally left blank.

4. FOS Segment Requirements

Section 4. contains the set of FOS segment-wide requirements.

4.1 FOS Segment Requirements Overview

This section specifies the requirements which are allocated to the Flight Operations Segment. The segment-wide operational, functional, and performance, external interfaces, security, operational availability, and evolution requirements are included in this section.

This section is organized as follows:

4.2 Operational and Functional Requirements

There are no unique AM-1 requirements for this section.

4.3 Performance Requirements

Segment-level performance requirements are specified in this section including capacities, capabilities, and throughput. Note that individual subsystem-level performance requirements are included in the subsystem section of this document.

4.3.1 EOC System Capacity

The EOC will be able to perform its defined functions under operational conditions. Table 4.3-1 summarizes the capacity requirements of several major simultaneously executable subsystem functions. The listed functions do not constitute the total of all functions to be supported within the stated utilization limits. The intent of the list is to define the load associated with a subset of known primary functions. The utilization limits apply to the total of these stated loads plus the loads associated with all other EOC functions.

The EOC will have sufficient capacity to support EOS mission operations as follows:

F-FOS-10200 The EOC shall utilize no more than 50 percent of each of its primary resources such as central processing units (CPUs), disk storage devices, and network communications capacities during any 20-minute period of AM-1 operational load conditions.

F-FOS-10205 The EOC shall utilize no more than 50 percent of its primary resources during any 20-minute period of peak load AM-1 operational conditions.

Note: The purpose of this requirement is to ensure an installed capacity adequate to support peak load operations for AM-1, which include launch and emergencies (i.e., anomaly investigations). The intent of the 50% resource utilization is to support the addition and enhancement of functions found to be necessary after segment acceptance.

Table 4.3-1. EOC System Capacity Requirements (1 of 2)

Functional Area	Function	Quantity
Scheduling	EOC Scheduling	1
	IST Scheduling	5
	Ground Script, ATC Load Generation	1
	RTS, Memory Mgt	3
Real-Time Operations	S/C Command - 10 kbps Housekeeping Telemetry - 16 kbps Diagnostic Telemetry - 16 kbps FDF Attitude Telemetry NCC Telemetry Back-Orbit Ingest Event Processing EDOS Real-Time Data (CODAs) NCC Operational Data Messages	1
	EOC User Station monitoring real-time	8 (normal) 24 (launch, anomaly investigation)
	IST monitoring real-time	4
Analysis	EOC Analysis: Anomaly Investigation Routine Analysis/Trending Dedicated Replay Weekly/Monthly Reports Standing Order	8

Table 4.3-1. EOC System Capacity Requirements (2 of 2)

Functional Area	Function	Quantity
	IST Analysis: Anomaly Investigation Routine Analysis/Trending Dedicated Replay Weekly/Monthly Reports Standing Order	6
Other	PDB Management	1

Notes: 1. All functions must be executed concurrently and continuously over the average period per normal representative operations.

2. Normal operations implies a typical load for the listed functions. Utilization levels apply to the sum total of all FOS functions.

4.3.2 IST Management

The FOS will enable the ISTs to establish network connections to the EOC to perform mission planning and scheduling, telemetry monitoring, and analysis functions. The FOS will provide the concept of a floating pool, which enables a maximum number of ISTs to have connections to the EOC and to ensure that each instrument is guaranteed access to at least one slot in the floating pool at any time.

F-FOS-10210 The FOS shall support up to 15 operational ISTs for the AM-1 mission that are connected to the EOC at any one time.

Note: The FOS will employ a floating pool concept whereby it manages the ISTs that are connected to the FOS. Up to 15 unique ISTs distributed between the AM-1 instruments may be connected to the EOC concurrently.

F-FOS-10215 The FOS shall provide ten dedicated, simultaneous IST connections at the following locations:

a. CERES: 2 in building 1250, LaRC, 2 in building TBD

b. MODIS: 2 at GSFC

c. MOPITT: 1 at University of Toronto; 1 at NCAR in Boulder

d. MISR: 2 at JPL

F-FOS-10220 The FOS shall provide six (6) additional, non-dedicated IST connections at the following locations:

a. CERES: 4 [1 at SAIC, 1 at building 1300, LaRC; 1 each at 2 other buildings TBD, LaRC

b. MODIS: 1 at GSFC

c. MISR: 1 at JPL

4.4 External Interfaces

4.4.1 EOS Project

There are no unique AM-1 requirements for this section.

4.4.2 Networks and NASA Elements

There are no unique AM-1 requirements for this section.

4.5 Security

There are no unique AM-1 requirements for this section.

4.6 Operational Availability

There are no unique AM-1 requirements for this section.

4.7 Evolution of Flight Operations

There are no unique AM-1 requirements for this section.

5. Hardware Requirements

This section delineates the specification level requirements for the FOS hardware. The specification level requirements provide enough detail to implement the FOS hardware configuration.

5.1 Real-Time Servers

This section is organized as follows:

5.1.1 Real-Time Server: Processors

5.1.2 Real-Time Server Local Disk Drives

There are no unique AM-1 requirements for this section.

5.1.3 Real-Time Server Local Tape Drive

There are no unique AM-1 requirements for this section.

5.1.4 Real-Time Server Local CD-ROM Drive

There are no unique AM-1 requirements for this section.

5.1.5 System Printers

There are no unique AM-1 requirements for this section.

5.1.6 Real-Time Server Hardware Cabinets

There are no unique AM-1 requirements for this section.

5.2 User Station

There are no unique AM-1 requirements for this section.

5.2.1 User Station Processors

There are no unique AM-1 requirements for this section.

5.2.2 User Station Printers

There are no unique AM-1 requirements for this section.

5.2.3 Video Hardcopy

There are no unique AM-1 requirements for this section.

5.2.4 User Station Hardcopy

There are no unique AM-1 requirements for this section.

5.3 Data Servers

There are no unique AM-1 requirements for this section.

5.3.1 Data Server: Processors

There are no unique AM-1 requirements for this section.

5.3.2 Data Server Disk Drives

There are no unique AM-1 requirements for this section.

5.3.3 Data Server Tape Drives

There are no unique AM-1 requirements for this section.

5.3.4 Data Server CD-ROM Drives

There are no unique AM-1 requirements for this section.

There are no unique AM-1 requirements for this section.

5.3.5 Data Server Hardware Cabinets

There are no unique AM-1 requirements for this section.

5.4 Data Storage Unit

F-HRD-13015 The RAID storage shall provide a minimum of 40 usable gigabytes.
Note: Amount of addressable disk after RAID has been implemented.

5.5 System Printers

There are no unique AM-1 requirements for this section.

5.6 Timing Interface

There are no unique AM-1 requirements for this section.

5.7 Internal Communication Network

5.7.1 Local Area Network

There are no unique AM-1 requirements for this section.

5.7.2 Network Test Equipment

There are no unique AM-1 requirements for this section.

5.8 Facility Requirements

There are no unique AM-1 requirements for this section.

5.8.1 EOC Equipment

There are no unique AM-1 requirements for this section.

6. Scheduling Requirements

Section 6. contains the requirements associated with the scheduling activity phase. This includes the Planning and Scheduling subsystem and the Command Management subsystem.

The Planning and Scheduling Subsystem is responsible for producing an integrated and conflict-free schedule of planned operations for the AM-1 spacecraft. A common set of planning and scheduling capabilities will be available to the FOS for supporting instrument and subsystem scheduling. For AM-1, the FOS will consist of the EOC which performs subsystem scheduling, constraint checking and schedule integration. The FOS also includes the CERES IST, MISR IST, MODIS IST and MOPITT IST where PIs are provided with instrument scheduling capabilities. Instrument plans and schedules for the ASTER instrument will be received by the external ASTER ICC located in Japan.

6.1 Planning and Scheduling Subsystem

The Planning and Scheduling Subsystem is responsible for producing an integrated and conflict-free schedule of planned operations for the AM-1 spacecraft. A common set of planning and scheduling capabilities will be available to the FOS for supporting instrument and subsystem scheduling. For AM-1, the FOS will consist of the EOC which performs subsystem scheduling, constraint checking and schedule integration. The FOS also includes the CERES IST, MISR IST, MODIS IST and MOPITT IST where PIs are provided with instrument scheduling capabilities. Instrument plans and schedules for the ASTER instrument will be received by the external ASTER ICC located in Japan.

This section is organized as follows:

6.1.6 Mission Events

6.1.7 Uplink Scheduling

6.1.8 Reports

6.1.1 Long Term Plans

The EOC will receive and maintain one Long Term Science Plan for the AM-1 spacecraft. The AM-1 Long Term Science Plan will be received approximately every six months from the System Monitoring and Coordination (SMC) element. The AM-1 Long Term Science Plan will define the primary science objectives for the AM-1 spacecraft.

The EOC will receive and maintain five Long Term Instrument Plans for the AM-1 spacecraft, including:

- ASTER Long Term Instrument Plan
- CERES Long Term Instrument Plan
- MISR Long Term Instrument Plan
- MODIS Long Term Instrument Plan
- MOPITT Long Term Instrument Plan

These Long Term Instrument Plans will be received approximately every six months from the System Monitoring and Coordination (SMC) element and cover a period of five years.

The EOC will create and maintain an AM-1 Long Term Spacecraft Operations Plan that includes planned operations for the following subsystems:

- power subsystem
- navigation subsystem (includes orbit maneuvers)
- Direct Access System

The AM-1 Long Term Spacecraft Operations Plan will span the life of the AM-1 mission.

F-PAS-10003 The EOC shall provide the AM-1 Long Term Science Plan to the ASTER ICC as specified in the ASTER ICC ICD.

F-PAS-10005 The EOC shall provide the AM-1 Long Term Instrument Plans to the ASTER ICC as specified in the ASTER ICC ICD.

F-PAS-10007 The EOC shall provide the AM-1 long term spacecraft operations plan to the ASTER ICC as specified in the ASTER ICC ICD.

6.1.2 Mission Plans

AM-1 planners will be able to use the generic capabilities for mission planning described in Volume 1. The only area where the AM-1 mission has specific requirements is the ASTER ICC interface.

F-PAS-10008 The FOS shall send predicted orbit data and planning aids from the FDF to the ASTER ICC as specified in the ASTER ICC ICD.

F-PAS-10009 The FOS shall notify the ASTER ICC when an ASTER activity in a mission schedule is affected by updated orbit data from FDF.

6.1.3 Mission Schedules

AM-1 planners will be able to use the generic capabilities for mission scheduling described in Volume 1. The only area where the AM-1 mission has specific requirements is the ASTER ICC interface. ASTER will be sending a list of activities to be included in the mission schedule.

F-PAS-10300 The EOC shall receive a list of ASTER activities from the ASTER ICC as specified in the ASTER ICC ICD.

F-PAS-10305 The EOC shall provide the AM-1 mission schedule to the ASTER ICC as specified in the ASTER ICC ICD.

6.1.3.1 Scheduling Activities

Activity definitions for AM-1's instruments, subsystems and ground operations will be available in the project database. The FOS will have the capability to schedule activities for the following mission elements:

- ASTER
- CERES
- MISR
- MODIS
- MOPITT
- power subsystem
- navigation subsystem
- Direct Access System
- TDRSS contacts (ground operations)
- omni antenna
- solid-state recorder
- high gain antenna

Since these categories of activities will be defined in the database, individual requirements are not included in this document. The generic capabilities described in Volume 1 will handle each of these cases with the exception of the ASTER interface. For ASTER the FOS will provide feedback on any activities in their list that could not be scheduled or that were deleted for some reason. Also, for ASTER the ability to trace activities to Directed Acquisition Requests (DARs) will be provided by the FOS.

F-PAS-10010 The EOC shall provide a list of ASTER activities that could not be included in the AM-1 mission schedule to the ASTER ICC.

F-PAS-10100 The FOS shall be able to receive DAR observation numbers.

F-PAS-10105 The FOS shall provide the capability for an authorized user to determine whether an activity is associated with an ASTER DAR.

F-PAS-10110 The FOS shall provide the capability to determine the observation number for an activity that is associated with an ASTER DAR.

6.1.3.2 Baseline Activity Profiles

The FOS will have the capability to define and schedule baseline activity profiles for the following AM-1 instruments:

- CERES
- MISR
- MODIS
- MOPITT

The EOC will have the capability to define and schedule baseline activity profile lists for the following AM-1 subsystems:

- Direct Access System

In addition, there may be a future identified need for scheduling activities related to the following mission elements:

- power subsystem
- navigation subsystem

In all of these areas the generic capabilities described in Volume 1 will be adequate.

6.1.3.3 Resource Profiles

The EOC will integrate all the AM-1 instrument and subsystem activities to produce a preliminary resource schedule. The data volume needs for the AM-1 spacecraft will be established in the preliminary resource schedule and used for determining TDRSS contact times.

The generic capabilities described in Volume 1 will be adequate for AM-1 with the following exceptions. There will be a capability to maintain AM-1 Solid State Recorder (SSR) buffer and data volume limits since this is the limiting resource on AM-1. There will also be a capability to provide the allocations of resources like SSR and power to the ASTER ICC. ASTER will be expected to send activity lists that are within their resource limits.

F-PAS-10310 The FOS shall provide the capability to change the AM-1 Solid State Recorder (SSR) buffer data volume limits.

F-PAS-10312 The FOS shall provide AM-1 resource allocations to the ASTER ICC.

Note: This allows ASTER to determine how much data buffer is available to them, when they can slew telescopes, whether power is limited, etc.

F-PAS-10315 The FOS shall accept resource reservation activities from the ASTER ICC.

Note: These 'place-holder' activities will allow ASTER to schedule activities without requiring specific pointing angles, dwell times, etc.

6.1.3.4 Communication Contacts

AM-1 will use the TDRSS spacecraft for real-time operations with the ground, recorder playback, load uplinks and health monitoring. For contingency purposes, AM-1 will utilize the DSN, GN and WOTS.

F-PAS-10400 The EOC shall provide the capability to schedule communication contacts with TDRSS through the NCC.

F-PAS-10405 The EOC shall provide the capability to receive TDRSS contact times from the NCC.

F-PAS-10410 The EOC shall provide the capability to schedule DSN communication contacts through the NCC.

F-PAS-10415 The EOC shall provide the capability to receive DSN contact times from the NCC.

F-PAS-10420 The EOC shall provide the capability to schedule communication contacts through the NCC.

F-PAS-10425 The EOC shall provide the capability to receive GN contact times from the NCC.

F-PAS-10430 The EOC shall provide the capability to schedule communication contacts through the NCC.

F-PAS-10435 The EOC shall provide the capability to receive WOTS contact times from the NCC.

F-PAS-10445 The EOC shall provide the capability to include AM-1 direct access system events on the AM-1 mission schedule.

Note: Direct access operates in the following modes: direct broadcast is for the MODIS instruments; direct downlink is for the ASTER instrument; and direct playback is a contingency mode for science data download for all instruments.

6.1.3.5 Detailed Activity Schedules

AM-1 planners will be able to use the generic capabilities for mission scheduling described in Volume 1. The only area where the AM-1 mission has specific requirements is the ASTER ICC interface. ASTER will be notified of the starting and ending times of the Detailed Activity Schedule so that they can avoid submitting activities within its boundaries.

F-PAS-10450 The EOC shall provide the Detailed Activity Schedule start and end times to the ASTER ICC.

F-PAS-10455 The EOC shall not schedule activities in an ASTER activity list that are within the boundaries of the Detailed Activity Schedule.

6.1.4 Constraints and Modeling

Constraints will be defined in the Project Database. The database will include the definition of whether a constraint is 'hard' or 'soft'. Therefore it will not be mandatory that 'soft' constraints exist or vice versa that any constraint violation cannot be allowed in the Detailed Activity Schedule. This section defines the specific modeling that the FOS will be required to do for the AM-1 spacecraft.

F-PAS-10500 The EOC shall provide the capability to model the AM-1 high gain antenna (HGA) pointing angles.

F-PAS-10505 The EOC shall provide the capability to identify activities that cause the AM-1 high gain antenna (HGA) to exceed its pointing limits as defined in the database.

F-PAS-10510 The EOC shall provide the capability to model AM-1 high gain antenna (HGA) slew times.

F-PAS-10515 The EOC shall provide the capability to identify activities that would require the high gain antenna (HGA) to slew faster than the maximum slew rate as defined in the database.

F-PAS-10530 The FOS shall provide the capability to change the buffer playback order of instrument science data for the Solid State Recorder (SSR).

F-PAS-10535 The FOS shall provide the capability to model the following modes for the CERES instrument:

a. Fixed Azimuth Scan (TBR)
b. Biaxial Scan (TBR)
c. Solar Calibration (TBR)
d. Launch (TBR)
e. Survival (off) (TBR)
f. Initialization (TBR)
g. Standby (TBR)
h. Save (TBR)
i. Diagnostic (TBR)

F-PAS-10540 The FOS shall provide the capability to model the following modes for the MISR instrument:

a. Global (TBR)
b. Local (TBR)
c. Calibration (TBR)
d. Dark (TBR)

e. Standby (TBR)

f. Safe (TBR)

g. Survival (TBR)

h. Test (TBR)

i. OFF (TBR)

F-PAS-10545 The FOS shall provide the capability to model the following modes for the MODIS instrument:

a. Launch (TBR)

b. Survival (TBR)

c. Safe (TBR)

d. Standby (TBR)

e. Outgas (TBR)

f. Science/Day (TBR)

g. Science/Night (TBR)

h. Calibration/SD View (TBR)

i. Calibration/SRCA View (TBR)

j. Calibration/Blackbody (TBR)

k. Calibration/Space (TBR)

F-PAS-10550 The FOS shall provide the capability to model the following modes for the MOPITT instrument:

a. Off (TBR)

b. Emergency (TBR)

c. Launch (TBR)

d. Idle (TBR)

e. Ready (TBR)

F-PAS-10555 The FOS shall provide the capability to model the following modes for the ASTER instrument based on activities received from the ASTER ICC:

a. Observation Mode

    1. Full (TBR)

    2. VNIR (TBR)

    3. VNIR Stereo (TBR)

    4. TIR (TBR)

    5. SWIR & TIR (TBR)

b. VNIR Calibration Mode

    1. Pre-Calibration (TBR)

2. Optical Calibration (TBR)
3. Dark Calibration (TBR)
4. Electric Calibration (TBR)

c. SWIR Calibration Mode
   1. Pre-Calibration (TBR)
   2. Optical Calibration (TBR)
   3. Dark Calibration (TBR)

d. VNIR & SWIR Calibration Mode
   1. Pre-Calibration (TBR)
   2. Optical Calibration (TBR)
   3. Dark Calibration (TBR)

e. TIR Long Term Calibration
   1. Pre-Calibration (TBR)
   2. Optical Calibration (TBR)
   3. Dark Calibration (TBR)

f. TIR Short Term Calibration
   1. Calibration 1 (TBR)
   2. Calibration 2 (TBR)

g. Pointing Mode
   1. VNIR (TBR)
   2. SWIR (TBR)
   3. TIR 1 (TBR)
   4. TIR 2 (TBR)

h. Standby Mode
   1. Standby 1 (TBR)
   2. Standby 2 (TBR)

i. All Off Mode (TBR)

j. Launch Mode (TBR)

k. Launch-lock Off Mode (TBR)

l. Safe Mode (TBR)

m. Survival Mode

n. Other Modes
   1. Cool Down (TBR)
   2. Prep 1
      a. TIR Prep 1 (TBR)

b. TIR Short Term Calibration 1 (TBR)

3. Prep 2
   a. Standby 2 (TBR)
   b. TIR Prep 2 (TBR)
   c. SWIR & TIR Prep (TBR)
   d. TIR Short Term Calibration 2 (TBR)
   e. TIR Pointing 2 (TBR)
4. TIR Getter
   a. TIR Getter Off (TBR)
   b. TIR Getter On (TBR)
5. TIR Cool Down (TBR)

F-PAS-10560 The FOS shall notify the ASTER ICC of any activities that they submitted that violate constraints.

F-PAS-10565 The FOS shall notify the ASTER ICC of the specific constraint that was violated for ASTER activities that violate constraints.

6.1.5 Performance Requirements

AM-1 planners will be able to use the generic capabilities for mission scheduling described in Volume 1. The only area where the AM-1 mission has specific requirements is the ASTER ICC interface.

F-PAS-10570 The EOC shall be able to schedule a list of TBD ASTER activities within TBD minutes after being submitted by the ASTER ICC.

F-PAS-10575 The EOC shall be able to return feedback of activities that could not be scheduled or that violate constraints within TBD minutes after being submitted by the ASTER ICC.

F-PAS-01040 The FOS shall be able to schedule TDRSS contact requests for a one week time period in less than 1 hour after all appropriate inputs have been received.

6.1.6 Mission Events

F-PAS-10605 The FOS shall provide the capability to determine the number of CERES scans between sunrise and sunset events for a given satellite orbit.

Note: The CERES instrument team will be able to use this predicted value as a command/activity parameter.

F-PAS-10615 The FOS shall provide predicted orbital information to the ASTER ICC.

F-PAS-10620 The FOS shall provide the capability to display target locations on a graphical map display with relation to spacecraft ground track.

Note: This is required in support of MISR instrument operations.

F-PAS-10625 The FOS shall provide the capability to determine MISR access to local mode targets.

Note: This is intended to be a textual list of orbits and times.

6.1.7 Uplink Scheduling

F-PAS-10700 The FOS shall provide the capability to identify valid uplink windows for MISR microprocessor loads.

Note: There will be a constraint in the database that limits these windows to nighttime only.

F-PAS-10705 The FOS shall display the valid uplink window for the MISR 16 day microprocessor load

6.1.8 Reports

There are no unique AM-1 requirements for this section.

6.2 Command Management Subsystem

The Command Management subsystem is responsible for providing tools used to manage the planned operations of the EOS spacecraft and their instruments. Planned operations are managed by means of ground scripts, preplanned command procedures, and spacecraft and instrument loads containing stored commands, data, or software. Ground scripts are created by CMS based on the DAS created by PAS. Preplanned command procedures are created by the Procedure Builder, described in Section 9.1.2.8, and validated by CMS.

Loads are generated by CMS from load content information. Load contents are built or received by CMS, depending on the load type. For some load types, the load contents are validated by CMS. CMS generates loads from load contents by reformatting the contents and preparing the load for uplink, or by simply preparing the load for uplink, depending on the load type. The five types of load contents used by CMS to generate loads are: absolute time command, which are created by CMS in a mission-specific format; relative time sequence, which are created either by FUI or externally to the FOS and must follow a format defined in the PDB; table, which are created either by FUI or externally to the FOS and must follow a format defined in the PDB; microprocessor, which are created externally to the FOS; and flight software, which are created externally to the FOS.

The CMS also generates reports on load contents and current uplink status and maintains information on the current state of spacecraft memory.

This section contains mission-specific requirements for the AM-1 spacecraft. This section is organized as follows:

6.2.1 ATC Loads

The ATC processor on AM-1 is called the SCC stored command processor. The absolute time commands are stored in the SCC stored command table. The SCC stored command table can contain up to 3000 absolute time commands. Each absolute time command consists of a time tag (3 octets), an inhibit identifier (1 octet), and command (20 octets). The commands in the buffer are processed in time order starting at the location of the ATC pointer. When the end of the table is reached, the processor wraps around to the first location again.

Each absolute time command in the SCC stored command table includes an inhibit identifier. This is used to inhibit the distribution of selected groups of commands by the SCC stored command processor. Before distributing an absolute time command, the SCC stored command processor checks the commands inhibit identifier against the SCC inhibit table. If the inhibit identifier is turned on in the inhibit table, the command will not be distributed.

F-CMS-10110 The EOC shall generate absolute time commands which are consistent with the format specified in ICD-106.

Note: The April, 1994 ICD-106 specifies that each absolute time command is of a fixed size of 24 octets, consisting of a time tag (3 octets), an inhibit identifier (1 octet), and command (20 octets).

F-CMS-10120 The EOC shall generate an ATC load in which the time tags associated with absolute time commands have a resolution of one second.

F-CMS-10125 The EOC shall generate absolute time commands with time tags in the following format: 2 bits representing day, 22 bits representing milliseconds of day.

F-CMS-10210 The EOC shall generate a SCC stored command table load that maps all absolute time commands into the SCC stored command table in a manner that is consistent with the format and processing of the SCC stored command table as described in SD-110a.

Note: The August, 1993 SD-110a indicates that absolute time commands should be mapped into the SCC stored command table in ascending time order, starting with the first available location and wrapping around to the first location in the table when the last location in the table has been filled.

F-CMS-10220 The EOC shall direct the placement of the ATC load such that the first command of the load is inserted into the SCC stored command table at the location immediately following the last meaningful command of the previous ATC load.

Note: The ATC load will not overwrite commands in the SCC stored command table that have not executed and are still planned to be executed.

F-CMS-10240 The EOC shall direct the placement of an ATC patch load such that the load may overwrite unexecuted commands in the SCC stored command table.

F-CMS-10250 The EOC shall append a load initiate command to the ATC load.

Note: The load initiate command includes the CRC, which is calculated by EOC software.

F-CMS-10255 The EOC shall format ATC loads for uplink according to the CCSDS Telecommand packet protocols as specified in ICD-106.

F-CMS-10410 If the size of the ATC load is greater than the available space in the SCC stored command table, the EOC shall provide the capability to partition the load.

Note: The available space in the SCC stored command table consists of the locations in the table between the first available location and the last available location. The first available location in the table is the location immediately following the last command of the previous load. The last available location in the table is the location immediately preceding the first command in the table which will not have been executed at the time the load is uplinked.

F-CMS-10420 If the size of the ATC load is greater than 4K bytes, the EOC shall provide the capability to partition the load.

F-CMS-10510 The EOC shall provide the capability to send the ATC Load Report to the ASTER ICC.

6.2.1.1 Absolute Time Command Generation

There are no AM-1 requirements for this section.

6.2.1.2 ATC Load Generation

There are no AM-1 requirements for this section.

6.2.1.3 ATC Load Uplink Scheduling

There are no AM-1 requirements for this section.

6.2.1.4 ATC Load Partitioning

There are no AM-1 requirements for this section.

6.2.1.5 ATC Load Management

There are no AM-1 requirements for this section.

6.2.2 Ground Script Generation

There are no AM-1 requirements for this section.

6.2.3 Relative Time Sequence (RTS) Loads

Relative time sequences in the SCC on AM-1 are called Relative Time Command Sequences (RTCS). There are 128 RTCS buffers available in the SCC. Each SCC relative time command consists of a time tag (2 octets) and command (20 octets). Each SCC RTCS buffer contains an inhibit identifier (1 octet), a command counter (1 octet), and up to 16 relative time commands.

F-CMS-10710 The EOC shall generate SCC relative time commands which are consistent with the format specified in ICD-106.

Note: The April, 1994 ICD-106 specifies that each absolute time command is of a fixed size of 22 octets, consisting of a time tag (2 octets), and a command (20 octets).

F-CMS-10720 The EOC shall verify that the time tags associated with SCC relative time commands in an SCC RTCS load have a resolution of 1 second.

F-CMS-10730 The EOC shall format RTS loads for uplink according to the CCSDS Telecommand packet protocols as specified in ICD-106.

F-CMS-10740 The EOC shall append a load initiate command to the RTS load.

Note: The load initiate command includes the CRC, which is calculated by EOC software.

F-CMS-10750 The EOC shall provide the capability to send the RTS Load Report to the ASTER ICC.

6.2.3.1 Building RTS Load Contents

There are no AM-1 requirements for this section.

6.2.3.2 RTS Load Generation

There are no AM-1 requirements for this section.

6.2.3.3 RTS Load Management

There are no AM-1 requirements for this section.

6.2.4 Table Loads

The FOS will provide tools for building spacecraft and instrument tables that are predefined in the PDB. The FOS tools will allow the user to edit the default values in the predefined table to build a new table, to provide new information for the fields of the table, or to use FDF-supplied data as input to the table. The table inputs will be validated using the PDB definition of each field in the table. The requirements for PDB defined table templates are found in the general FOS requirements volume.

Certain tables will be generated and scheduled for uplink automatically upon receipt of routine FDF data. The format for these tables will be specified in the FDF/EOC ICD. The requirements for generating tables from FDF data are found in the general FOS requirements volume.

F-CMS-11185 The EOC shall format table loads for uplink according to the CCSDS Telecommand packet protocols as specified in ICD-106.

F-CMS-11190 The EOC shall append a load initiate command to the table load.

6.2.4.1 Building Table Load Contents

There are no AM-1 requirements for this section.

6.2.4.2 Table Load Generation

There are no AM-1 requirements for this section.

6.2.4.3 Table Load Management

There are no AM-1 requirements for this section.

6.2.5 Instrument Microprocessor Loads

Load contents for CERES, MISR, MODIS, and MOPITT instrument microprocessor loads will be provided by the IOT. The EOC will format these load contents into messages that are compatible with the C&DH C&T bus (MIL-STD-1553B). Also, the EOC will append the load initiate command to the load data.

A CRC will be used to verify the successful uplink of the load. The EOC will compute this CRC when generating the load from the load contents.

F-CMS-11310 The EOC shall provide the capability to format CERES, MISR, MODIS, and MOPITT instrument microprocessor load content into 1553B messages.

F-CMS-11320 The EOC shall provide the capability to calculate the CRC for a CERES, MISR, MODIS, or MOPITT instrument microprocessor load.

Note: The CRC algorithm will be provided by the individual instrument teams.

F-CMS-11330 The EOC shall provide the capability to append the load initiate command, including the load descriptor, start address, word count, and CRC to a CERES, MISR, MODIS, or MOPITT instrument microprocessor load.

F-CMS-11340 The EOC shall format CERES, MISR, MODIS, and MOPITT microprocessor loads for uplink according to the CCSDS Telecommand packet protocols as specified in ICD-106.

6.2.6 Flight Software Loads

F-CMS-11410 The EOC shall format flight software loads for uplink according to the CCSDS Telecommand packet protocols as specified in ICD-106.

F-CMS-11420 The EOC shall append a load initiate command to the flight software load.

Note: The load initiate command includes the CRC, which is calculated by EOC software.

6.2.7 Integrated Report

The integrated report contains a chronological list of information related to orbital events, command executions, and real-time contacts that are expected to occur during the target day.

F-CMS-11510 The EOC shall provide the capability to send the Integrated Report to the ASTER ICC.

6.2.8 Load Generation Performance

There are no AM-1 requirements for this section.

6.2.9 Memory Images

F-CMS-11720 The EOC shall provide the capability to generate a report of intermediate SUROM results based on a memory dump.

6.2.10 Command Procedure Validation

There are no AM-1 requirements for this section.

This page intentionally left blank.

7. Real-Time Operations

Section 7. contains the requirements associated with the Real-Time Operations activity phase. This includes the Resource Management, Telemetry and Command subsystems

7.1 Resource Management Subsystem

The Resource Management Subsystem (RMS), provides the capability to manage and monitor the configuration of the EOC. This includes configuring the EOC resources for multi-mission support; facilitating operational failure recovery during real-time contacts; and managing the real-time interface with the NCC.

The Resource Management Subsystem is responsible for controlling and coordinating the necessary resources for telemetry monitoring and spacecraft commanding. RMS enables EOC users to receive and monitor telemetry from one or more spacecraft and one or more instruments.

The Resource Management Subsystem receives requests from users for command authority. The EOC allows users to request the privilege to send commands to an EOS spacecraft. The Resource Management Subsystem grants this privilege to authenticated users, and ensures that only one person has command authority for a single spacecraft at any one time.

This section is organized as follows:

7.1.1 Resource Allocation

There are no unique AM-1 requirements in this section.

7.1.2 User Authorization

There are no unique AM-1 requirements in this section.

7.1.3 Failure Recovery

There are no unique AM-1 requirements in this section.

7.1.4 Monitor EOC Status

There are no unique AM-1 requirements in this section.

7.1.5 Interface with NCC

There are no unique AM-1 requirements in this section.

7.2 Telemetry Subsystem

The EOC will provide the capability to receive, process, and monitor telemetry data from the EOS spacecraft. The Real-time Telemetry subsystem will accept EDOS Data Units (EDU) from EDOS or other specified source, extract the CCSDS standard packets from the EDUs, and process those packets whose application identifiers are specified in the Project Data Base. All telemetry processing capabilities described in this section are performed during real-time processing, unless stated otherwise.

This section delineates the specification level requirements for the FOS telemetry subsystem. Related specification requirements are grouped together and described using specification narratives.

The telemetry requirements are organized as follows:

Section	Title
7.2	Telemetry Subsystem
7.2.1	Telemetry Delivery
7.2.1.1	Accept Telemetry Data
7.2.1.2	Process EDOS Data Units
7.2.2	Telemetry Packet Processing
7.2.2.1	Determine Telemetry Packet Quality
7.2.2.2	Process CCSDS Telemetry Packets
7.2.2.3	Decommutate Telemetry
7.2.3	Telemetry Parameter Processing
7.2.3.1	Mark Static Telemetry
7.2.3.2	Decommutate Telemetry Parameters
7.2.3.3	Decommutate Context-dependent Telemetry Parameters
7.2.3.4	Perform Derived Parameter Calculations
7.2.3.5	Check High/Low and Delta Limit Values
7.2.3.6	Report Limit Conditions
7.2.3.7	Adjust Parameter Limit Values
7.2.3.8	Convert to Engineering Units (EU)
7.2.3.9	Access Decommutated Telemetry

7.2.4 Telemetry Store and Replay

7.2.4.1 Store Real-time and Spacecraft Recorder Telemetry

7.2.4.2 Replay Stored Telemetry

7.2.5 Special Data Collection and Processing

7.2.5.1 Collect Spacecraft and Instrument Computer Memory Dump

7.2.5.2 Collect Spacecraft Attitude Data

7.2.5.3 Compare Expected Spacecraft State with Telemetry

7.2.6 Non-telemetry Message Processing

7.2.6.1 Process Non-telemetry Messages

7.2.1 Telemetry Delivery

7.2.1.1 Accept Telemetry Data

The EOC will accept EOS spacecraft and instrument telemetry from multiple telemetry sources.

F-TLM-10125 The EOC shall be capable of receiving AM-1 housekeeping and AM-1 diagnostic telemetry data from both the I-channel and Q-channel simultaneously.

Note: For example, the EOC will be able to accept telemetry with the I and Q channels in the following configurations:

2 - 16 kbps housekeeping

or

1 - 16 kbps housekeeping and

1- 16 kbps diagnostic

F-TLM-10130 The EOC shall be capable of receiving the 1 kbps AM-1 health and safety telemetry data from both the TDRSS S-band and launch vehicle simultaneously.

Note: This requirement assumes that AM-1 provides the capability of differentiating between the two health and safety streams.

7.2.1.2 Process EDOS Data Units

There are no unique AM-1 requirements for this entire section.

7.2.2 Telemetry Packet Processing

7.2.2.1 Determine AM-1 Telemetry Quality

Each EDOS Data Unit (EDU) contains error information within its header that is used for computing the quality of the telemetered AM-1 CCSDS packet.

7.2.2.2 Process AM-1 CCSDS Telemetry Packet

The FOS processes AM-1 CCSDS packets that contain housekeeping, health and safety, memory dump (diagnostic), spacecraft recorder, and instrument engineering data. The packets will be identified via the application process identifier (APID) within each packet primary header. The expected packet length for each APID will be predefined. If the telemetry packet APID and packet length are not of predefined values, the packet will not be decommutated. AM-1 telemetry packets contain a packet secondary header. Located within the secondary header is the spacecraft inserted packet time mark.

F-TLM-10410 The FOS shall accept AM-1 CCSDS format telemetry packets of a predefined type and length.

Note: The FOS will support both pure CCSDS packet telemetry and Time Division Multiplexed (TDM) type telemetry transferred within the CCSDS packets, such as that implemented for AM-1.

F-TLM-10415 The FOS shall accept AM-1 1664 octet housekeeping telemetry packets.

F-TLM-10420 The FOS shall accept AM-1 1664 octet diagnostic telemetry packets.

F-TLM-10425 The FOS shall accept AM-1 208 octet health and safety telemetry packets.

F-TLM-10430 The FOS shall accept AM-1 208 octet diagnostic telemetry packets.

F-TLM-10435 The FOS shall accept AM-1 208 octet standby CTIU telemetry packets.

F-TLM-10436 The FOS shall accept AM-1 instrument science telemetry packets of lengths up to 7695 octets.

Note: Instrument engineering data will be decommutated from the science telemetry stream. Instrument engineering telemetry decommutation will not occur real-time as this data is not routed to the EOC during spacecraft contact periods.

F-TLM-10440 The FOS shall extract from the telemetry packet primary header field the following:

a. The 11-bit packet APID.

b. The 14-bit packet sequence count.

c. The two (2) octet packet length count.

Note: The FOS will examine the AM-1 CCSDS packet sequence count located within the primary header to determine a proper major cycle sequence and to detect missing cycles.

F-TLM-10445 The FOS shall generate a notification message whenever a missing AM-1 major cycle is detected.

Note: Each missing major cycle notification message will contain the detection time (UTC) and the total number of major cycles recognized as being missed.

F-TLM-10455 The FOS shall be capable of extracting the 1649 octet telemetry information from the 16 Kbps AM-1 housekeeping packet application data field.

F-TLM-10460 The FOS shall be capable of extracting the 1649 octet telemetry information from the 16 Kbps AM-1 diagnostic packet application data field .

F-TLM-10465 The FOS shall be capable of extracting the 193 octet telemetry information from the 1 Kbps AM-1 health and safety packet application data field.

F-TLM-10470 The FOS shall be capable of extracting the 193 octet telemetry information from the 1 Kbps AM-1 diagnostic packet application data field.

F-TLM-10475 The FOS shall be capable of extracting the 193 octet telemetry information from the 1 Kbps AM-1 standby CTIU packet application data field.

F-TLM-10480 The FOS shall be capable of extracting up to 7680 octets of telemetry information from the low-rate science packet application data field.

F-TLM-10485 The FOS shall be capable of extracting up to 1025 octets of telemetry information from the high-rate science packet application data field.

Note: Requirements 10480 and 10485 permit the processing of AM-1 instrument engineering data.

F-TLM-10490 The FOS shall provide the capability to convert the packet time stamp according to the CCSDS Day Segmented Time Code time conversion algorithm.

7.2.2.3 Decommutate AM-1 Telemetry

The FOS provides the capability to accept and decommutate AM-1 spacecraft and instrument housekeeping, instrument engineering, diagnostic, and health and safety telemetry based on established, predefined telemetry format information. The FOS will support telemetry decommutation for the following spacecraft subsystems:

a. C&DHS
b. COMMS
c. EAS
d. EPS
e. FSW
f. GN&CS
g. PROPS
h. SMS
i. TCS

The FOS will support telemetry decommutation for the following instruments:

a. ASTER

b. CERES (FORE, AFT)

c. MISR

d. MODIS

e. MOPITT

F-TLM-10525 The FOS shall determine the decommutation algorithm for a telemetered AM-1 CCSDS packet based upon the packet application process identifier (APID) and packet sequence count fields.

Note: The FOS will apply algorithms on the packet sequence count that will correlate the packet to the spacecraft major cycle(s). For example, the FOS will identify the AM-1 housekeeping major cycle by using a modulo-64 of the packet sequence count. The FOS will use a modulo-32 of the health and safety packet sequence count multiplied by two, to determine the AM-1 major cycle in which the packet started.

F-TLM-10535 The FOS shall be capable of continuously decommutating real-time spacecraft housekeeping telemetry at a rate of 16 Kbps.

F-TLM-10540 The FOS shall be capable of continuously decommutating real-time instrument housekeeping telemetry at a rate of 16 Kbps.

F-TLM-10550 The FOS shall be capable of decommutating real-time spacecraft diagnostic telemetry at a rate of 16 Kbps.

F-TLM-10555 The FOS shall be capable of decommutating real-time instrument diagnostic telemetry at a rate of 16 Kbps.

F-TLM-10560 The FOS shall be capable of continuously decommutating real-time spacecraft health and safety telemetry at a rate of 1 Kbps.

F-TLM-10565 The FOS shall be capable of continuously decommutating real-time instrument health and safety telemetry at a rate of 1 Kbps.

F-TLM-10570 The FOS shall be capable of decommutating real-time spacecraft diagnostic telemetry at a rate of 1 Kbps.

F-TLM-10575 The FOS shall be capable of decommutating real-time instrument diagnostic telemetry at a rate of 1 Kbps.

F-TLM-10580 The FOS shall be capable of decommutating real-time spacecraft standby CTIU telemetry at a rate of 1 Kbps.

F-TLM-10585 The FOS shall be capable of decommutating replayed instrument engineering telemetry at a rate of 16 Kbps.

7.2.3 Telemetry Parameter Processing

7.2.3.1 Mark Static Telemetry

There are no unique AM-1 requirements for this section.

7.2.3.2 Decommutate AM-1 Telemetry Parameters

There are no unique AM-1 requirements for this entire section.

7.2.3.3 Decommutate AM-1 Context-dependent Telemetry Parameters

The FOS provides for the proper decommutation of telemetry parameters which are themselves dependent upon key parameter telemetry points.

F-TLM-10810 FOS shall provide decommutation of a given location of a given major cycle to be associated with any one of various parameter mnemonics, depending on the value of a discrete telemetry context switch parameter.

7.2.3.4 Perform AM-1 Derived Parameter Calculations

The FOS will provide an AM-1 pseudotelemetry processing capability that accommodates special computations using predefined algorithms. These simple calculations will be done via derived parameters. Derived parameters are built by combining existing parameters via arithmetic or logical functions. It will be possible to use predefined analog, discrete, constant, or other derived values as a source to build a new derived parameter.

F-TLM-11320 The FOS shall provide the capability to process a maximum of fifty (50) AM-1 derived parameters at a given time.

7.2.3.5 Check High/Low and Delta Limit Values

There are no unique AM-1 requirements for this section.

7.2.3.6 Report Limit Conditions

There are no unique AM-1 requirements for this section.

7.2.3.7 Adjust Parameter Limit Values

There are no unique AM-1 requirements for this section.

7.2.3.8 Convert to Engineering Units (EU)

The FOS provides the capability to convert decommutated telemetry data from raw counts to engineering units (EUs). Conversions are performed using predefined calibration coefficients and may be based upon the following:

a. Seventh order or lower polynomial functions

b. Linear interpolation and line segment approximations of up to 15 segments (using 15 pairs of start and end-points) per conversion.

c. Exponential function conversion.

F-TLM-10955 The FOS shall be capable of performing EU conversions using an exponential function with three coefficients.

Note: Exponential conversion will use the following equation:

$$y = C_0 + C_1 e^{(c_2 x)}$$

where x is the raw value, C_i is a data base defined coefficient, e has a value of 2.718, and y is the converted value.

7.2.3.9 Access Decommutated Telemetry

There are no unique AM-1 requirements for this section.

7.2.4 Telemetry Store and Replay

7.2.4.1 Store AM-1 Real-time and Spacecraft Recorder Telemetry

The EOC has the capability of storing the downlinked AM-1 real-time and playback spacecraft recorder housekeeping telemetry.

F-TLM-11515 The EOC shall be capable of receiving and storing AM-1 real-time housekeeping telemetry at rates up to 16 Kbps.

F-TLM-11520 The EOC shall be capable of receiving and storing AM-1 spacecraft recorder playback housekeeping telemetry at rates up to 512 Kbps.

Note : The 512 Kbps rate will be used during emergency operations through the DSN, GN, or WOTS. The nominal AM-1 playback rate will be 256 Kbps. The spacecraft recorder data will be captured at EDOS and may be transmitted to the EOC post-contact at rates up to 1.544 Mbps.

F-TLM-11525 The EOC shall be capable of receiving and storing real-time instrument engineering telemetry at rates up to 50 Kbps for each EOC controlled spacecraft.

Note: AM-1 instrument engineering data will be routed directly to the DAAC. Therefore, the EOC does not store AM-1 instrument engineering telemetry data.

7.2.4.2 Replay Stored Telemetry

There are no unique AM-1 requirements for this section.

7.2.5 Special Data Collection and Processing

7.2.5.1 Collected Spacecraft and Instrument Computer Memory Dump

There are no unique AM-1 requirements for this section.

7.2.5.2 Collect Spacecraft Attitude Data

There are no unique AM-1 requirements for this section.

7.2.5.3 Compare Expected Spacecraft State with Telemetry

There are no unique AM-1 requirements for this section.

7.2.6 Non-telemetry Message Processing

There are no unique AM-1 requirements for this section.

7.3 Command Subsystem

The Command Subsystem provides the capability to: validate, build, uplink and verify real-time commands for the EOS spacecraft and instruments: uplink and verify memory loads for the EOS spacecraft and instruments; and verify execution of stored commands for the EOS spacecraft and instruments during a real-time contact.

Note: The level 3 requirements document makes reference to "command groups", which this document cites as "command procedures".

This section is organized as follows:

7.3.1 Command Providers

7.3.1.1 Transmission Configurations

The EOC will have the capability to transmit commands to the EOS spacecraft using the SN, GN, DSN or WOTS via the EDOS interface. Additionally, the EOC will allow for commanding of the spacecraft simulator

Note: there are no mission specific requirements for this section.

7.3.1.2 Uplink Rates

The EOC will support all mission uplink rates. The various data rates are associated with command configurations which are used to select the appropriate data rate.

F-CMD-11210 The EOC shall uplink at a rate of 10 kilobits per second (kbps) when the control center is configured for transmission utilizing SN SSA service and the AM1 High Gain antenna.

F-CMD-11211 The EOC shall uplink at a rate of 125 bits per second (bps) when the control center is configured for transmission utilizing SN SSA service and the AM1 Omni antenna.

F-CMD-11212 The EOC shall uplink at a rate of 1 kilobits per second (kbps) when the control center is configured for transmission utilizing SN SMA service and the AM1 High Gain antenna.

F-CMD-11215 The EOC shall uplink at a rate of 2 kbps when the EOC is configured for transmission utilizing the GN service and the AM1 Omni antenna.

F-CMD-11220 The EOC shall uplink at a rate of 2 kbps when the EOC is configured for transmission utilizing the DSN service and the AM1 Omni antenna.

F-CMD-11225 The EOC shall uplink at a rate of 2 kbps when the EOC is configured for transmission utilizing the WOTS service and the AM1 Omni antenna.

7.3.1.3 Command Types

The EOC will be capable of transmitting operator input commands, command procedures, ground scripts, and command loads. Command procedures and ground scripts will be processed identical to operator input commands. Instrument commands and spacecraft commands will be processed identically. Inasmuch as the commands are being processed by a single processing stream, the commands from these different sources will be merged into a single uplink stream.

Note: there are no mission specific requirements for this section.

7.3.2 Command Generation

7.3.2.1 CCSDS Protocol Support

For each spacecraft and its instruments, uplink data that conform to the CCSDS Telecommand Standard will be prepared.

The EOC will transmit uplink data conforming to Command Operations Procedure-1 (COP-1) and Frame Operations Procedure-1 (FOP-1) transmission verification mechanisms will be implemented as specified in CCSDS 202.1-B-1, Telecommand Part 2.1 Command Operation Procedures, of October 1991.

Additionally, COP-1 / FOP-1 transmission verification mechanisms will be implemented as specified in ICD-106 of 19 April 1994.

F-CMD-12130 The EOC shall utilize a single virtual channel for uplink.

7.3.2.2 Generation of Commands

The EOC will provide the capability to build real-time mnemonic formatted commands based on operator input and validate the command syntax.

Additionally, binary commands are supported.

F-CMD-12240 The EOC shall accept user supplied binary (hex) formatted commands.

Note: Other than the critical prompt, neither validation nor verification is provided for commands entered in binary format.

F-CMD-12245 The EOC shall generate commands in 1553-B format.

Note: This format is specified in ICD-106 of 19 April 1994. Also note that the CTIU commands are formatted in 1553-B format.

7.3.3 Pretransmission Validations

7.3.3.1 Prerequisite State Checking

The EOC will perform data base defined prerequisite state checking of mnemonic commands prior to command uplink. Prerequisite state checking confirms spacecraft states by checking the specified telemetry values, in real time. Commands failing the check will not be transmitted to the spacecraft.

Note: there are no mission specific requirements for this section.

7.3.3.2 Critical Commands

The EOC will provide the capability to control the uplink of critical commands by requiring a second positive response from the operator. If a command procedure or ground script is being executed, authorization is required for each critical command to be uplinked.

F-CMD-13230 The EOC shall treat commands entered in binary (hex) format as critical commands.

7.3.3.3 Load File Validation

The EOC provides validation of load data files by checking load information.

Note: there are no mission specific requirements for this section.

7.3.3.4 Command Authorization

The EOC will ensure that there is a single point of command for the spacecraft and its instrument manifest.

Note: there are no mission specific requirements for this section.

7.3.4 Command Transmission

7.3.4.1 Command Processing

Note: there are no mission specific requirements for this section.

7.3.4.2 Command Retransmission

The EOC will provide for automatic retransmission of commands which were unsuccessfully transmitted.

Commands are retransmitted when it is recognized (through CCSDS COP-1 protocol) that (one or more) commands were not successfully transmitted to the spacecraft.

Note: there are no mission specific requirements for this section.

7.3.4.3 CTIU Selection

F-CMD-14310	The EOC shall be capable of addressing commands to either of the two Command and Telemetry Interface Units (CTIU).
F-CMD-14313	The EOC shall address all commands to the active CTIU by default.
F-CMD-14315	The EOC shall provide the user with the capability to select either of the two CTIUs as the active CTIU.

7.3.5 Verification of Commands

Commands are verified in two ways. Command receipt verification verifies that uplinked commands were received intact on board the spacecraft. This is accomplished through the CCSDS protocol. Telemetry verification verifies that the commands were successfully executed. This is accomplished by checking real time telemetry after allowing sufficient time for the command to execute, and the telemetry to downlink.

7.3.5.1 Command Receipt Verification

Command receipt verification is provided by the receipt of the Command Link Control Word (CLCW) of the CCSDS processing.

Note: there are no mission specific requirements for this section.

7.3.5.2 Telemetry Verification

F-CMD-15245 The EOC shall allow a pre-defined duration time of up to one minute after receipt verification before determining that a command has failed telemetry verification.

Note: The pre-determined time is defined per command, and is based upon onboard execution time; transmission time is not taken into account. This is because the verification wait period does not begin (in real time) until after the CLCW has been received; the transmission delay period for the CLCW is identical to that for the telemetry, and this accounts for the transmission delay.

7.3.5.3 External ICC Commanding Notifications

Note: there are no mission specific requirements for this section.

7.3.5.4 ICC Emergency Notification

Note: there are no mission specific requirements for this section.

7.3.5.5 Telemetry Verification of Stored Commands

Commands are forwarded by the command subsystem at a time corresponding to their execution on board the spacecraft. Although transmission, retransmission and prechecking of these commands is suppressed, verification of stored commands is otherwise identical to that for operator input commands.

F-CMD-15515 The EOC shall provide the capability to verify via telemetry the successful dispatch of absolute time stored commands.

F-CMD-15520 The EOC shall provide the capability to verify via telemetry the successful dispatch of relative time stored commands.

This page intentionally left blank.

8. Analysis

Section 8. contains the requirements associated the subsystem that provides services used for the FOS activity phases. This includes the Analysis subsystem.

8.1 Data Access

This section is organized as follows:

8.2 Data Base Usage

There are no unique AM-1 requirements for this section.

8.3 Analysis Requests

There are no unique AM-1 requirements for this section.

8.4 Analysis Products

There are no unique AM-1 requirements for this section.

8.4.1 Dataset

There are no unique AM-1 requirements for this section.

8.4.2 Performance Monitoring

There are no unique AM-1 requirements for this section.

8.4.3 Reports

There are no unique AM-1 requirements for this section.

8.5 Statistics

There are no unique AM-1 requirements for this section.

8.5.1 System Generated Statistics

There are no unique AM-1 requirements for this section.

8.5.2 User Selectable Statistics

There are no unique AM-1 requirements for this section.

8.6 Algorithms and Special Processing

There are no unique AM-1 requirements for this section.

8.6.1 Data Manipulation

There are no unique AM-1 requirements for this section.

8.6.2 Spacecraft Monitoring

There are no unique AM-1 requirements for this section.

8.6.3 User Supplied Algorithms

There are no unique AM-1 requirements for this section.

8.7 Real Time Analysis

The FOS will provide tools to manage the SSR.

F-ANA-17010 The FOS shall provide the capability to monitor the AM-1 Solid State Recorder buffers in real-time.

F-ANA-17020	The FOS shall provide the capability to detect RF failures which impact SSR playbacks.
F-ANA-17030	The FOS shall provide the capability to report the state of the SSR playback at the time of an RF failure.
F-ANA-17040	The FOS shall provide the capability to report the status of the SSR buffers at the end of a contact. Note: The report will be made available to Planning and Scheduling for planning subsequent contacts for SSR playback.
F-ANA-17050	The FOS shall provide the capability to recommend recovery procedures to correct for playback data loss.
F-ANA-17060	The FOS shall provide the capability to recommend recovery procedures to correct RF link faults.

8.7.1 EDOS/NCC Processing

There are no unique AM-1 requirements for this section.

8.7.2 Clock Drift Error Calculation

There are no unique AM-1 requirements for this section.

8.7.2.1 Perform RDD Spacecraft Clock Correlation

There are no unique AM-1 requirements for this section.

8.7.2.2 Perform USCCS Spacecraft Clock Correlation

There are no unique AM-1 requirements for this section.

8.7.2.3 Spacecraft Clock Correlation Reports

There are no unique AM-1 requirements for this section.

8.7.3 Spacecraft Activity Log Monitoring

There are no unique AM-1 requirements for this section.

8.8 Performance and Status

There are no unique AM-1 requirements for this section.

8.9 Expert Advisor

There are no unique AM-1 requirements for this section.

This page intentionally left blank.

9. Support Services

Section 9. contains the requirements associated with subsystems that provide services used for the three FOS activity phases. This includes the User Interface subsystem and the Data Management subsystems.

9.1 User Interface Subsystem

The user interface subsystem is responsible for the human-machine interface for the EOC and IST workstations. This includes displaying telemetry, providing means for users to request analysis and other processing, displaying the results of the requests, providing commanding interfaces, as well as providing a host of user tools such as electronic mail, context sensitive help, and a document reader.

This section is organized as follows:

9.1.10.1 Event Display

9.1.10.2 Event History Request

9.1.1 FUI General

9.1.1.1 Screen Management

There are no unique AM-1 requirements for this section.

9.1.1.2 User Customization

There are no unique AM-1 requirements for this section.

9.1.1.3 Manipulation

There are no unique AM-1 requirements for this section.

9.1.1.4 User Authentication

There are no unique AM-1 requirements for this section.

9.1.1.5 Command Language

There are no unique AM-1 requirements for this section.

9.1.1.6 Window Requirements

There are no unique AM-1 requirements for this section.

9.1.2 Tools

9.1.2.1 Quick Message Generator

There are no unique AM-1 requirements for this section.

9.1.2.2 Data Mover

There are no unique AM-1 requirements for this section.

9.1.2.3 Replay Controller

The FOS will provide the capability to control the replay of archived telemetry data. The following requirements describe the functions to be provided by the FOS for the replay controller.

F-FUI-12310 The FOS shall provide the ability to select the replay rate in multiples of 16 kilobits per second up to 48 kilobits per second.

F-FUI-12315 The FOS shall provide the means of stepping forward through the telemetry data by single major cycles.

9.1.2.4 Document Reader

There are no unique AM-1 requirements for this section.

9.1.2.5 E-Mail

There are no unique AM-1 requirements for this section.

9.1.2.6 Display Builder

The FOS will provide the user with the capability to define a real-time display. The following requirements define the functions that the FOS will provide with the display builder.

F-FUI-12610 The FOS shall include a master/major cycle count in the Display Builder palette.

9.1.2.7 Help

There are no unique AM-1 requirements for this section.

9.1.2.8 Procedure Builder

The FOS provides the user with the capability to create, edit, store, print, and delete preplanned procedures. These procedures typically contain directives that are related to a single function (e.g., directives to safe an instrument). The FOS will provide standard editing capabilities coupled with FOS-specific functions, such as procedure syntax checking and requests for command validation. A command builder function will also be provided with the editor to assist the user in constructing directives. The command builder will present lists of valid directive components (e.g., directive keyword, mnemonic descriptors, etc.) that a user may select and insert into the procedure text. The following requirements define the procedure building capability that will be provided by the FOS. The term authorized user indicates that the user must either be the owner (i.e., creator) of the procedure or have system administrator privileges.

F-FUI-12800 The FOS shall provide the capability to import and convert OASIS procedures. Any OASIS directives that are not directly convertible to ECL directives will be flagged as "UNCONVERTED".

Note: The FOS cannot automatically validate the procedures. It is the explicit responsibility of the FOT to manually convert any unconverted directives. An FOT member must designate and sign off each procedure as valid.

9.1.2.9 Reports

There are no unique AM-1 requirements for this section.

9.1.2.9.1 Report Template Builder

There are no unique AM-1 requirements for this section.

9.1.2.9.2 Report Generation

There are no unique AM-1 requirements for this section.

9.1.2.9.3 Report Browser/Editor

There are no unique AM-1 requirements for this section.

9.1.3 Utilities

9.1.3.1 Time Selection

There are no unique AM-1 requirements for this section.

9.1.3.2 Selection Filter

There are no unique AM-1 requirements for this section.

9.1.4 Planning and Scheduling

There are no unique AM-1 requirements for this section.

9.1.5 Command Management

9.1.5.1 Table Load Builder

There are no unique AM-1 requirements for this section.

9.1.5.2 RTS Load Builder

There are no unique AM-1 requirements for this section.

9.1.5.3 Ground Script Display

There are no unique AM-1 requirements for this section.

9.1.5.4 ATC Buffer Display

There are no unique AM-1 requirements for this section.

9.1.5.5 RTS Buffer Display

There are no unique AM-1 requirements for this section.

9.1.5.6 Load Catalogs

There are no unique AM-1 requirements for this section.

9.1.6 Commanding

9.1.6.1 Procedure Control

There are no unique AM-1 requirements for this section.

9.1.6.2 Command Requests

There are no unique AM-1 requirements for this section.

9.1.6.3 Command Control

There are no unique AM-1 requirements for this section.

9.1.7 Monitor Telemetry

9.1.7.1 Real-Time Display

There are no unique AM-1 requirements for this section.

9.1.7.2 Alphanumeric Displays

The alphanumeric displays will display telemetry parameters in real-time, updating at a user selectable rate from 1 to 60 seconds. From an alphanumeric display, a user will be able to view discrete and analog telemetry parameters, their data quality and any limit violations. A user will be able to define the format of an alphanumeric display and then save the format for later use.

F-FUI-17200 The FOS shall be capable of displaying master/major cycle count.

F-FUI-17265 The FOS shall provide the capability to display the inhibit flags.

F-FUI-17270 The FOS shall provide the capability to display the spacecraft activity log.

9.1.7.3 Graphs

There are no unique AM-1 requirements for this section.

9.1.7.4 Tables

There are no unique AM-1 requirements for this section.

9.1.7.5 Schematics

There are no unique AM-1 requirements for this section.

9.1.7.6 Info Window

The Info window will display a column of up to 50 telemetry value mnemonics and respective columns of associated data from the Project Data Base (PDB). This data will include cycle locations, valid discrete states, analog conversion polynomials, limits, etc.

F-FUI-17600 The FOS shall display data base information about the master and major cycles that the telemetry value is extracted from.

9.1.7.7 Status Window

The status window will display a fixed set of data, associated with a single logical string, updating at a user selectable rate from 1 to 60 seconds. This window will display Universal Time Coordinated (UTC), spacecraft time, count down clock, current orbit number, data source, current cycle count, current telemetry format, current telemetry rate and spacecraft identifier.

F-FUI-17700 The FOS shall display current master/major cycle count.

9.1.7.8 Solid State Recorder Analysis Window

The Solid State Recorder (SSR) analysis window will display SSR buffer data in real-time. This will include SSR buffer pointers, SSR buffer status, SSR playback state, and RF failures that impact SSR playbacks. The SSR analysis window will also display recommended recovery procedures to correct for playback loss and RF fault links, provided by the analysis subsystem.

F-FUI-17800 The FOS shall provide a SSR analysis window that contains:

a. buffer pointers
b. buffer status
c. playback state
d. RF failures

F-FUI-17810 The FOS shall display recommended playback data loss recovery procedures.

F-FUI-17820 The FOS shall display recommended RF fault link correction procedures.

9.1.8 Resource Management

There are no unique AM-1 requirements for this section.

9.1.9 Analysis

9.1.9.1 Analysis Requests

There are no unique AM-1 requirements for this section.

9.1.9.2 Analysis Results

There are no unique AM-1 requirements for this section.

9.1.9.3 Standing Orders

9.1.9.3.1 Standing Order Manager

There are no unique AM-1 requirements for this section.

9.1.9.3.2 Standing Order Browser

There are no unique AM-1 requirements for this section.

9.1.9.4 Quick Analysis

There are no unique AM-1 requirements for this section.

9.1.9.5 Algorithm Registration

There are no unique AM-1 requirements for this section.

9.1.10 Data Management

9.1.10.1 Event Display

There are no unique AM-1 requirements for this section.

9.1.10.2 Event History Request

There are no unique AM-1 requirements for this section.

9.2 Data Management Subsystem

The Data Management Subsystem is responsible for supporting FOS mission operations. This function is performed through three types of services; data base generation, file management and event processing. This section provides the detail level requirements necessary to perform these services.

This section is organized as follows:

9.2.1 Project Data Base

9.2.1.1 PDB Inputs

F-DMS-10110 The FOS shall provide the capability to exclude processing of duplicate CERES data.

Note : This requirement will be handle by context dependent definitions.

9.2.1.2 PDB Edit

There are no unique AM-1 requirements for this section.

9.2.1.3 PDB Validation

There are no unique AM-1 requirements for this section.

9.2.1.4 PDB Reporting

There are no unique AM-1 requirements for this section.

9.2.1.5 PDB Backup, Restore and Compare

There are no unique AM-1 requirements for this section.

9.2.1.6 Operational Data Base Generation

There are no unique AM-1 requirements for this section.

9.2.2 File Management

There are no unique AM-1 requirements for this section.

9.2.2.1 Telemetry Archive

There are no unique AM-1 requirements for this section.

9.2.2.2 Ground-Telemetry Archive

There are no unique AM-1 requirements for this section.

9.2.2.3 Events Archive

There are no unique AM-1 requirements for this section.

9.2.2.4 File Archive

There are no unique AM-1 requirements for this section.

9.2.2.5 Long-Term Archive

There are no unique AM-1 requirements for this section.

9.2.3 Event Message Processing

There are no unique AM-1 requirements for this section.

9.2.4 Ground Telemetry

There are no unique AM-1 requirements for this section.

Appendix A. Level 4 Traceability Matrix

See Volume 1 for Appendix A.

This page intentionally left blank.

Appendix B. Level 4 Attributes Matrix

See Volume 1 for Appendix B.

This page intentionally left blank.

Appendix C. Level 3 to Level 4 Traceability Matrix

See Volume 1 for Appendix C.

This page intentionally left blank.

Abbreviations and Acronyms

See Volume 1 for Abbreviations and Acronyms

This page intentionally left blank

Glossary

See Volume 1 for the Glossary.